Vol. XX. NOVEMBER, 1895. No. 11.

THE BOTANICAL GAZETTE

EDITORS:

JOHN M. COULTER, Lake Forest University, Lake Forest, Ill.
CHARLES R. BARNES, University of Wisconsin, Madison, Wis.
J. C. ARTHUR, Purdue University, Lafayette, Ind.

CONTENTS:

Recording apparatus for the study of transpiration of plants. (With plate XXX.)—*Albert F. Woods* 473
New or peculiar aquatic fungi. II. (With plate XXXI.)—*Roland Thaxter* 477
Observations on the development of Uncinula spiralis. (With plates XXXII and XXXIII.)—*B. T. Galloway* 486
Notes from my herbarium.—*Walter Deane* 492
Noteworthy anatomical and physiological researches 496
Root tubercules on Ailanthus.—*Theo. Holm.*
Studies upon galls.—*Theo. Holm.*
The combined effects of geotropism and heliotropism.—*D. T. MacDougal.*
Briefer Articles 501
Distribution of the Russian thistle in North America. (With a map.)—*Lyster H. Dewey.*
Observations upon the dissemination of seeds.—*Margaret F. Boynton.*
Some western weeds, and alien weeds in the west.—*T. D. A. Cockerell.*
Current Literature 505
Open Letters 510
The nomenclature question.—*John H. Barnhart.*
Decapitalization.—*F. A. Bather.*
Notes and News 512

[ISSUED NOVEMBER 17.]

MADISON, WISCONSIN.
PUBLISHED BY THE EDITORS.

Tracy, Gibbs & Co., Printers, Madison, Wisconsin.

THE BOTANICAL GAZETTE

A Monthly Journal Embracing all Departments of Botanical Science.

ANNUAL SUBSCRIPTION, $3.00.

SINGLE NUMBERS, 30 CENTS.

The subscription price must be paid in advance. No numbers are sent after the expiration of the time paid for. No reduction is made to dealers or agents.

In Great Britain, 14 shillings.
Agents, WM. WESLEY & SON,
28, Essex st., Strand, London.

In Germany, 14 marks.
Agents, R. FRIEDLÆNDER & SOHN,
Carlstrasse 11, Berlin, N. W. 6

The prices named include postage.

Subscriptions and business correspondence should be addressed to the **BOTANICAL GAZETTE, MADISON, WIS.**; money orders and drafts should be made payable to the BOTANICAL GAZETTE.

Separate Copies.—Contributors are furnished on request 25 separate copies of their articles (free) when 2 pp. long or more. Additional copies will be supplied at the following rates: For each 4 pages or less, per 100, $1.50; for each plate, per 100, $1.00. A less number at the same rate. Covers like GAZETTE, with title, $1.50 per 100, additional. ☞ *The number desired must be marked* **at the head of the MS.**, *as none will be printed unless ordered.*

Manuscripts.—Contributors are requested to write scientific and proper names with particular care, and in citations to follow the form shown in the pages of the GAZETTE. Manuscripts may be sent to any one of the editors.

Illustrations and advertisements.—Articles requiring illustrations and correspondence about advertisements should be addressed to **J. C. ARTHUR, Purdue University, Lafayette, Ind.**

Missing Numbers.—Will be replaced *free* only when claim is made within 30 days after receipt of the number following.

[Entered at the Post-office at Madison, Wis., as second-class postal matter.]

In the November number will appear:

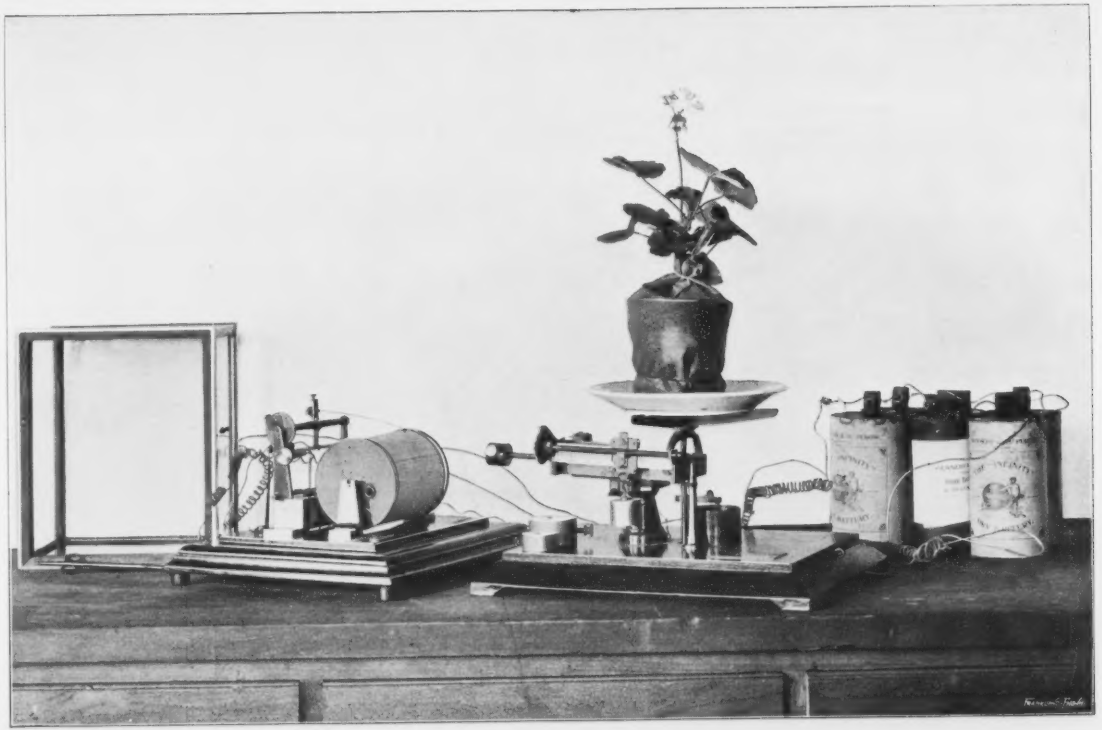
New or peculiar aquatic fungi. III, by DR. ROLAND THAXTER, *Harvard University, Cambridge, Mass.*

Dr. Thomas Coulter, by FREDERICK V. COVILLE, *chief of the Division of Botany, U. S. Dep't of Agric., Washington, D. C.*

Undescribed plants from western Mexico, by MERRITT L. FERNALD, *Gray Herbarium, Harvard University, Cambridge, Mass.*

Undescribed plants from Guatemala and other Central American republics. XVI, by JOHN DONNELL SMITH, *Baltimore, Md.*

Noteworthy anatomical and physiological researches.



WOODS on APPARATUS for RECORDING TRANSPIRATION.

BOTANICAL GAZETTE

NOVEMBER, 1895.

Recording apparatus for the study of transpiration of plants.[1]

ALBERT F. WOODS.

WITH PLATE XXX.

Of the various methods devised for determining the amount of water evaporated by plants, none is so satisfactory as the direct one of weighing the plant at given periods. Weighings, however, as ordinarily carried on, are more or less unsatisfactory, for unless the operation is repeated at short intervals, a broken record is the result. To obviate this difficulty, various devices have been used. Some of these weigh the loss from the plant direct, while others operate by the indirect method of weighing the water absorbed by calcium chloride, sulphuric acid, etc. Of the last mentioned class the Anderson registering balance[2] is an admirable device which with some slight modifications might be made to record directly loss in weight. At the suggestion of Mr. B. T. Galloway, the writer has recently made some changes in Marvin's recording rain and snow gauge which fits it for very satisfactory work in measuring continuously the loss of water from transpiring plants. Prof. Marvin, of the United States Weather Bureau, very kindly assisted us in making the changes. The apparatus consists essentially of two parts, a balance and a register. (PLATE XXX.) The two parts are in an electrical circuit which is opened or closed whenever the equilibrium of the balance is disturbed. When the circuit is closed, the movement of the armature of the magnet mounted on the left arm of the balance engages a notched wheel which turns a long screw set parallel to the beam. This screw works in a half nut attached to the carriage of the

[1] Read before section G, A. A. A. S., Springfield meeting, August, 1895.
[2] Bull. Geol. and Nat. Hist. Surv. Minn. 9: 117–180. 27 S. 1894.

counterweight and is adjustable, so that the weight may be set at any point along the beam. For recording evaporation, a left hand screw is used, moving the weight from left to right. As evaporation from the plants goes on, the right arm of the scale rises, thus closing the circuit above the beam. The armature of the magnet is then attracted and turns the screw carrying the counterweight; at the same time the pen on the register is carried along by a similar mechanism. This is continued until the balance is brought to equilibrium and the circuit broken. Further evaporation causes a repetition of the process. The beam is protected from objectionable up and down swing by a dasher attached to the vertical stem supporting the scale pan and working in a cup of glycerin.

The register is shown on the right of the plate. It is exactly the same as that used for recording rainfall. Prof. Marvin describes it as follows:[3] "The record cylinder is mounted upon a horizontal axis with the clock movement inside. The cylinder makes one revolution in twelve hours. The mechanism giving motion to the pen consists of an electro-magnet and armature similar to those on the weighing gauge, and of a notched wheel fixed upon the end of a screw having cut upon it both a right and left hand thread of coarse pitch, viz., three threads to the inch. A cylindrical sleeve slides upon this screw, being guided by a slender rod below and parallel to the screw. A slender spring, with the recording pen attached to its point, is connected adjustably to the sleeve by a double friction joint which enables the pen to be set with great facility, the friction holding it accurately and firmly where placed.

"The armature of the electro-magnet engages directly the teeth of the notched wheel upon the right and left hand screw in such manner as to cause it to revolve tooth by tooth, always in one direction, with each vibration of the armature. The sleeve moving upon the screw is fitted with a crescent-shaped attachment which enters the thread of the screw. When the sleeve is set with the crescent in the thread at one end of the screw, the pen will, when the screw is revolved, be moved to the opposite end, the crescent-shaped piece being then guided into the other thread, and thus, upon continued rotation of the screw, causing the pen to return again to the

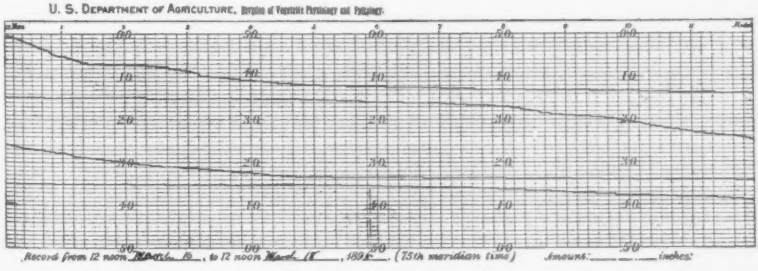
[3] U. S. Weather Bureau. Cir. E, Instrument Room.

starting point. Here the crescent nut will again pass into the thread first followed, and again carry the sleeve across the screw. The reciprocating motion of the pen thus secured is strictly in a straight line, and the subdivisions of the scale of the record sheet are equal throughout, conditions that are extremely desirable, especially in a recording rain gauge where rate of rainfall is to be obtained."

The equal subdivisions of the scale thus obtained also greatly facilitate the determination of the rate of evaporation.

The record sheet is divided into hours by lines running parallel to the axis of the cylinder; the hours are subdivided into spaces of ten minutes. Lines representing grams are drawn at right angles to the hour lines. The value of these spaces can be regulated by varying the weight of the counterpoise on the balance. Our instrument is set up so that each space equals one gram. One movement of the armature carries the counterpoise a distance equal to one-tenth of a gram and the pen at the same time moves across one-tenth of a gram space on the record sheet. Once across the sheet equals fifty grams. When the pen has recorded this amount it passes back, making the record in the other direction as before explained.

Below is shown a record of evaporation from a fuchsia from 12 M. March 16th to 12 M. March 18, 1895. It is one sheet of

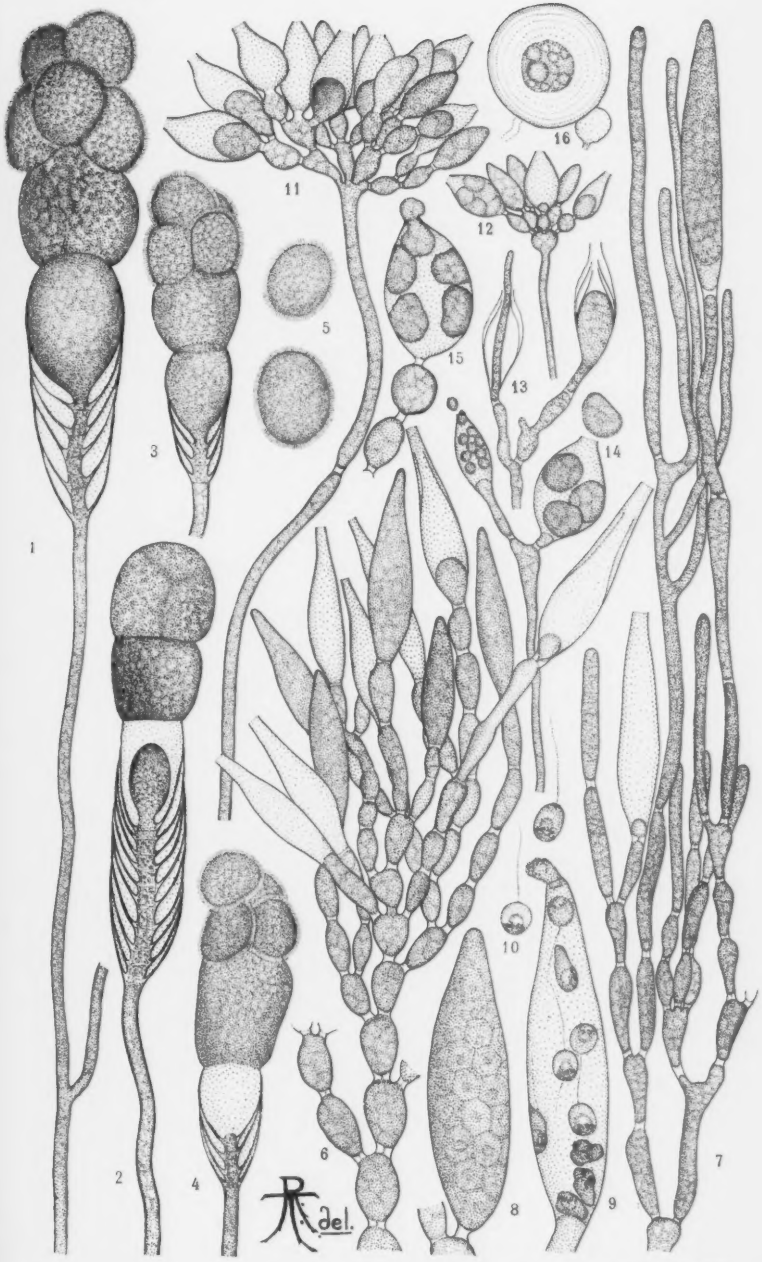

U. S. Department of Agriculture, Division of Vegetable Physiology and Pathology.
Record from 12 noon March 16, to 12 noon March 18, 1895. (75th meridian time.) Amounts: inches.

a continuous record for the month of March. The pen was started at 12 M. March 16th at the top of the sheet. From 12 M. to 1:25 P. M. the loss was at the rate of one gram for each ten minutes. During this time the plant was exposed to direct sunlight. At 1:25 a screen was placed between the plant and the sun. The rate of evaporation was greatly

checked, being only about one-tenth of a gram in ten minutes. At 2:30 P. M. the screen was removed. The intensity of the light was much lower than from 12 to 1:25, but greater than what the plant had been exposed to behind the screen. The increase in loss is proportional to the increased intensity of the light. The total loss from 12 M. to 6 P. M. is seen to be 12.1^{gm} from 6 P. M. to 12 midnight nine-tenths of a gram, 12 midnight to 6 A. M. 1^{gm}, 6 A. M. to 12 M. 9^{gm}, 12 M. to 6 P. M. 6.5^{gm}.

March 16th was clear, the 17th two-tenths cloudy, the 18th eight-tenths cloudy. The total amount lost for the whole period was 39^{gm}. This brief explanation in connection with the record will show how easily and accurately comparisons may be made for any period of time or the total evaporation determined at any time during the experiment. With automatic devices for recording temperature, humidity, intensity of light, and barometric pressure, it will be possible to obtain data on the much talked about but little understood problems of transpiration. The instrument can be very easily modified so that it will record either gain or loss in weight. With the help of Prof. Marvin we hope to simplify it and increase its range of usefulness in physiological work. Plate XXX is reproduced from a photograph of the complete apparatus as at present used.

Division of Vegetable Physiology and Pathology,
U. S. Department of Agriculture, Washington, D. C.



THAXTER on AQUATIC FUNGI.

HELIOTYPE PRINTING Co. BOSTON

Contributions from the Cryptogamic Laboratory of Harvard University. XXVIII.

New or peculiar aquatic fungi. 2. Gonapodya *Fischer* and Myrioblepharis, *nov. gen.*

ROLAND THAXTER.

WITH PLATE XXXI.

GONAPODYA Fischer.

In the preceding note on Monoblepharis reference was made to the history of this genus which was erected by A. Fischer[1] to receive the single species formerly described by Reinsch[2] as *Saprolegnia siliquaeformis*. The form was subsequently referred by Cornu[3] to his *Monoblepharis prolifera*[4] but since this name had not been associated with any description or recognizable figure and since its relation to Monoblepharis must remain in doubt until more definite information is obtained concerning its sexual reproduction, it would seem proper to retain for the type the specific designation given by Reinsch. It is moreover quite uncertain from published data whether the forms referred to by Cornu and Reinsch are really identical, since a second species described below as *G. polymorpha* is, in this country at least, far more abundant than *G. siliquaeformis*, and may well be the species observed by Cornu. In this author's criticism[3] of Reinsch's paper incidental mention is made of the fact that since the publication of his monograph in 1872, he had observed the oospores, which he describes as oval, colorless, contained in oogonia similar to the zoosporangia and resulting from a fertilization of the oosphere by motile antherozoids. Beyond this mere statement, which, to the writer's regret, was overlooked in connection with the previous note on Monoblepharis, no further information and no figures of any kind have been published. Although, however, this statement must be accepted as it stands, from so

[1] Rabh. Kryptogamenfl. **1**[4]: 382. 1892.
[2] Pringsheim's Jahrb. f. wiss. Bot. **11**: 293. 1876.
[3] Bull. Bot. Soc. de France **24**: 227. 1877.
[4] Idem **18**: 59. 1871.—Annales d. Sci. Nat. Bot. V. **15**: 16. 1872. Van Tieghem, Traite de Botanique 1029. *fig. 620, 2.*

high an authority, it seems within the bounds of possibility that he may have been misled as to the presence of antherozoids by the extensive variations in size exhibited by the zoospores in certain instances (fig. 14), while the writer must confess that he has himself been several times misled as to the presence of oospores by the encystment of secondary sporangia within the empty primary sporangium, which sometimes occurs under unfavorable conditions. The presence of uniciliate zoospores (which are perhaps not invariably produced in this genus) can hardly be considered very significant in view of the fact that such zoospores are known to occur in other genera, even were it not true that in at least one species of Monoblepharis (*M. fasciculata*), if not in all, biciliate zoospores are normally produced.

In other respects the genus bears no resemblance to Monoblepharis in appearance or mode of growth, and is well defined through the correlation of successively proliferous sporangia with a habit corresponding essentially to that which distinguishes the order LEPTOMITACEÆ (APODYEÆ Fischer), namely the segmentation of its hyphæ through the presence of successive constrictions, each corresponding to a pseudoseptum formed by a deposit of cellulin (?) which nearly closes the passage from one segment to another except for a central perforation through which the protoplasm of adjacent segments may usually be seen to be continuous. This segmentation, however, although as a rule so conspicuous a feature in *G. siliquaeformis*, is sometimes almost wholly absent from, or at least greatly obscured in, the common and very variable species which I have called *G. polymorpha*. The "cellulin rings" in this species are sometimes unassociated with any marked constriction and are sparingly distributed, while in other instances the segmentation is as pronounced as in *G. siliquaeformis*, involving the entire vegetative body when the plant is short in habit, or often confined for the most part, as in fig. 11, to terminal groups of branchlets which are borne on more or less undifferentiated and sparingly pseudo-septate filaments.

The zoosporangia in both species are in general similarly shaped, though much shorter, stouter and smaller in *G. polymorpha*, tapering from a more or less inflated basal portion to the narrow tip which becomes terminally perforate for the emission of the zoospores. The sporangia may be once to several times proliferous and in *G. polymorpha* specimens are

sometimes seen in which the hypha grows on through and beyond the empty sporangium eventually producing new sporangia at its top. The encystment of sporangia formed by proliferation within the empty primary sporangium has already been referred to and has been observed in a number of instances where the fungus was growing under unfavorable conditions surrounded by a mass of bacteria and other plants. The resemblance of such encysted sporangia to oospores is often misleading, but it must be admitted that the walls in such cases cannot be compared in thickness to mature spores of Rhipidium.[5]

The zoospores in both species are peculiar in appearance and though sometimes more or less evenly granular, are more commonly sufficiently transparent to show distinctly the large spherical nucleus just in front of which lies a coarsely granular mass characteristically disposed (fig. 10). Each zoospore makes its exit independently and after a short period, during which it undergoes rather rapid amoeboid changes of form, swims away. Zoospores when examined in a partly emptied sporangium may often be seen to creep over its inner surface with an amoeboid motion (fig. 9 below) sometimes disengaging themselves and swimming free in the cavity. In *G. polymorpha* the variations in size exhibited by the zoospores are very remarkable even in the same specimen which may show the extremes represented in fig. 14 produced side by side. The presence of antherozoids in the plant was at first suggested by this great discrepancy, but extended examination shows the occurrence of every degree of variation connecting these extremes.

Reinsch in the paper already mentioned figures[6] a sporangium in which sporangiola are supposed to have developed from the walls of an empty sporangium, but as such a development is a manifest impossibility, it seems probable that the objects figured are rather zoospores which having been unable to escape have germinated in the position indicated.

In several specimens of *G. polymorpha* oospores such as are represented in fig. 16, have been found associated with the zoosporic form, but in no instance was the material sufficiently good to show the hyphal connections of these spores. They are remarkable for their enormously thickened walls, and

[5] Cornu l. c.
[6] l. c., *pl. 15. fig. 13.*

completely fill the oogonium. In almost every specimen examined the small rounded antheridium was present at the side recalling that of species of Rhipidium. It is quite uncertain, however, whether these spores are really connected with the zoosporic form which they accompany.

GONAPODYA SILIQUAEFORMIS (Reinsch). *Plate XXXI, figs. 6–10.*

Saprolegnia siliqaeformis Reinsch l. c.
Gonapodya prolifera Fischer l. c. Schroeter in Engler and Prantl Natürl. Pflanzenfam. 93: 107. 1893.

Hyphæ rather stout, more or less regularly divided into short elliptical to long clavate segments, copiously and successively sub-umbellately branched, the branches diverging in a dense tuft from a common base. Sporangia often once to three times proliferous, long pod shaped, inflated below, the sometimes very elongate distal portion tapering gradually to a blunt apex; borne sessile on the terminal cell of a branch or separated from it by a clearly defined constriction. Zoospores numerous (more than fifty), uniciliate, oval or elliptical with conspicuous nuclei. Oospores (*sec.* Cornu) oval in terminally perforate oogonia like the sporangia. Hyphæ 250–500μ long, the segments normally about $25 \times 14\mu$, but varying greatly. Sporangia, average $130 \times 22\mu$, sometimes 200–250μ long.

On decaying apples in water. Cambridge, Mass., and Kittery Point, Maine.

This species appears to be decidedly rare and has been collected by the writer on two occasions only, growing in dense tufts which formed small pustules on the surface of the substratum above mentioned, and there seems to be no record of its occurrence since it was found by Reinsch in a similar situation. It is distinguished by its very large tapering sporangia, the distal portion of which is sometimes very greatly elongated. Though its hyphæ are commonly rather regularly segmented, forms occur which present great irregularities in this respect, especially through the elongation of terminal branchlets into slender often unsegmented filaments, in a fashion frequently more pronounced than that which is represented in fig. 7. The secondary sporangia are often quite distinct from base to apex within the primary ones, though more commonly the distal portion only is distinct as is represented in fig. 6.

Gonapodya polymorpha, n. sp. *Plate XXXI, figs. 11–16.*— Hyphæ irregularly branched, more or less regularly divided into short oval or irregular segments, the segmented portion arising directly from the substratum or more often confined to tufts of branchlets borne sub-umbellately on the ends of slender elongate hyphæ in which the segmentation is indistinct or obsolete; the segmentation frequently ill-defined or obsolete throughout the whole vegetative body. Sporangia variable in size and form, long-oval, tapering rather abruptly to the blunt tip, terminal and solitary or sometimes several arising from a single segment, once to several times proliferous, the hypha sometimes traversing and growing beyond the empty sporangium. Zoospores very variable in size and number. Hyphæ 200–1000μ long. Sporangia 20–60 × 12–30μ.

On submerged twigs and other vegetable matter. Vicinity of Cambridge, Mass., and Kittery Point, Maine.

This species seems very common and may be obtained from almost any body of still water. Its variability is extraordinary and did not intermediate forms constantly occur one would not hesitate to separate specifically, if not generically, forms in which the segmentation of the hyphæ is most prominent and those in which it is nearly obsolete. Careful search, however, shows the presence of pseudo-septa unassociated with constrictions even in the unsegmented forms. When the segmentation is pronounced it is often even more clearly defined than in *G. siliquaeformis*, as in fig. 15, and in such instances the segmented portions are more often confined to tufts of branchlets borne on slender hyphæ as in figs. 11 and 12.

The oospores represented in fig. 16 have several times been found unassociated with any other zoosporic form, but, as has been already mentioned, a definite connection between the two has not been traced. They occur near the base of the ordinary filaments embedded in the mass of bacteria and foreign matter which is usually associated with this plant. These oospores, which recall those of Rhipidium in several respects, are about 54μ in diameter, the laminated refractive walls 18μ thick, with the rounded antheridium usually persistent.

The extremes of size exhibited by the zoospores are shown in fig. 14 in two sporangia which were borne side by side on the same filament. The general appearance of the zoospores

also varies greatly, resembling in most cases those of *G. siliquaeformis*, but often densely granular throughout. In some instances the zoospores have seemed to be biciliate.

MYRIOBLEPHARIS.

In examining the material from which the species of Monoblepharis already described were derived, I encountered in one instance a singular fungus, remarkable alike for its energetic movements and the unusual character of its zoospores, to which I propose to give the above generic name. In a hasty examination of several preparations the form was at first passed over as an animal, perhaps a rotifer or some similar organism, which had attached itself, either by accident or as a parasite, upon the sporangium of a Pythium. Further investigation, however, made it clear that the surprisingly active mass of protoplasm which commonly terminates the plant was concerned in the production of its zoospores, the formation of which was watched from beginning to end in a number of specimens.

The vegetative body of the fungus consists of slender, continuous hyphæ which, arising for the most part singly from the substratum and remaining simple or becoming sparingly branched, bear at their tips the peculiar sporangia represented in the illustrations (figs. 1–4). The primary sporangium is broadly oblong, or elliptic, terminally broadly papillate, and at maturity emits its contents very rapidly in the form of a single mass of protoplasm which at once commences a spasmodic irregularly rotary movement, the violence of which constantly increases. This mass remains adherent to the extremity of the empty sporangium which immediately begins to become proliferous, a new sporangium forming within it very rapidly and at maturity discharging its contents as in the first instance. As a result of this second discharge the first mass is carried up by the second (fig. 2), and each continues its rotating motion, while a third sporangium begins to form rapidly as before within the empty walls of the second. When this third sporangium is beginning to approach maturity, the mass first discharged divides rather rapidly into usually four parts (fig. 3), which undergo very violent movements, whirling around upon one another with great rapidity, but still retaining their position at the summit of the mass discharged from the second sporangium. The third sporan-

gium then empties itself, carrying up the second mass, and, just as this occurs, the rotating bodies above the latter slowly separate from it and from one another, and almost immediately swim off as zoospores. The successive formation of sporangia and the discharge of new masses then continues, the series of sporangia remaining constantly surmounted by two rotating protoplasmic masses, the upper of which breaks up into free swimming zoospores just at the period when a third mass is being discharged. In this way more than a dozen empty sporangia are often superposed as in fig. 2, the series being traversed by the filament which bears them, from the tip of which new sporangia are successively produced. In rarer instances the filament may grow through the sporangium last emptied, and, after having attained a variable length, produces terminally a new series of sporangia as already described. Occasionally, when the successive formation of sporangia has been more than usually rapid, two successively discharged masses may unite with one another, as is shown in fig. 4, where the contents of the sporangium represented in fig. 3 has been discharged and united with the previously discharged mass above it, the two becoming quite indistinguishable from one another.

The successively discharged masses appear to be held in place by, and to go through their peculiar movements within, a perfectly hyaline gelatinous envelope in which each is discharged. The envelope of the first mass does not appear to be broken by the second discharge, and seems to be sufficiently elastic to withstand its pressure until the third discharge takes place, at which moment it is ruptured distally, and allows the escape of the zoospores, which are at this moment fully matured. In this way a series of gelatinous envelopes, corresponding to the series of empty sporangia, is formed, extending from the edges of the mouth of the first sporangium up around the whole series and beyond them to include the two lower masses last discharged. The figures given in the present connection do not show this envelope, being drawn from living material in which its character was not determined. Stained preparations show it very clearly, however, and serve to explain the otherwise inexplicable fixity in position of the three successively discharged masses.

At the time when the zoospores are ready to separate and make their escape, which usually is not less than half an hour

after their discharge as an unsegmented mass, their surface in living material may be seen to be very conspicuously covered with innumerable cilia, as is represented in the illustrations; and, although this has not been made out satisfactorily in living material, stained preparations show that the masses within the gelatinous envelope are similarly ciliate when first discharged. The number of zoospores developed from a single mass is usually four, but is subject to occasional variation, two having been observed in small specimens while in the example represented in fig. 1, the number, originally four, has been increased to five by the division into two of one which was larger than the rest.

Although resembling some species of Pythium both in its slender hyphæ and proliferous sporangia, this genus seems to be clearly distinguished from all other Phycomycetes by its multiciliate zoospores and their peculiar process of formation. In fact no other zoospores, except those of Vaucheria among the algæ, are known to the writer to possess a similar disposition of cilia. The fate of the zoospores after their escape was not observed, and the sexual reproduction is as yet unknown.

Myrioblepharis, nov. gen. *Plate XXXI, figs. 1–5.*—Hyphæ slender, sparingly branched, bearing terminally zoosporangia becoming many times proliferous and forming an elongate series traversed by the hypha from the successive proliferations of which they arise. Zoospores very large, multiciliate over their whole surface, resulting from the division of the contents of the sporangia which make their exit as a single ciliated mass surrounded by a gelatinous membrane attached to the distal end of the sporangium, the successive envelopes, after rupturing distally, persistent around the series of empty sporangia.

Myrioblepharis paradoxa, nov. sp.—Characters of the genus. The contents of the sporangium dividing into two or four (rarely more) zoospores which are carried upward by the discharged contents of the two sporangia subsequently formed before making their escape from their inclosing envelope. Hyphæ slender, flexuous, seldom more than once or twice branched, about 1^{mm} long, 4–5μ in diameter, sometimes growing through the terminal sporangium of a series and subsequently producing a new series in a similar fashion. Zoospores broadly oval or oblong, 20–30μ × 18–20μ.

On submerged sticks with Monoblepharis, etc. Weston, Mass.

Harvard University.

Explanation of Plate XXXI.

Myrioblepharis paradoxa Thaxter.

Fig. 1. Branched filament, showing a series of six sporangia, the sixth just ready to empty itself, its papillate tip hidden by the mass above it derived from the fifth sporangium; the contents of the fourth sporangium have divided into five zoospores which escaped immediately after the sixth sporangium discharged its contents.

Fig. 2. A hypha having a series of eleven sporangia, the eleventh half developed, the contents of the ninth borne on that of the tenth, and beginning to segment.

Fig. 3. A condition similar to that represented in fig. 1: the contents of the second sporangium having divided into four zoospores, the fourth sporangium just ready to discharge its contents.

Fig. 4. The same specimen, after the dehiscence of the fourth sporangium, the contents of which have united with those of the third while the zoospores derived from the contents of the second are separating to make their escape.

Fig. 5. Two zoospores showing the extremes of size observed.

Gonapodya siliquæformis (Reinsch) Thaxter.

Fig. 6. Portion of a plant showing elongate segments with two sporangia, one of them empty.

Fig. 7. Portion of a plant showing typical habit; seven of the sporangia are empty, and two of them are once proliferous.

Fig. 8. Sporangium, the contents of which have segmented to form zoospores, its base connected with a segment by a well defined constriction.

Fig. 9. A sporangium, partly emptied, sessile on its segment, the four lower zoospores creeping on the inner surface of the wall.

Fig. 10. Zoospores showing nucleus and anterior granular mass.

Gonapodya polymorpha Thaxter.

Figs. 11–12. Portion of two plants in which the segmented parts are borne sub-umbellately on slender hyphæ.

Fig. 13. Proliferous sporangia, borne on hypha, in which the segmentation is almost obsolete.

Fig. 14. Two sporangia on the same hyphæ, illustrating the extreme variation in the size of zoospores.

Fig. 15. Two segments very clearly distinguished, bearing terminally a sporangium from which the zoospores are escaping.

Fig. 16. Thick walled oospore with antheridium found associated with the zoosporic form, but not definitely connected with it.

***Note.—Figures 1–5, 8–10, 13–15, are drawn with Zeiss obj. D, oc. 4, the remainder with obj. D, oc. 2. All the figures reduced by photo-lithography.

Observations on the development of Uncinula spiralis.[1]

B. T. GALLOWAY.

WITH PLATES XXXII AND XXXIII.

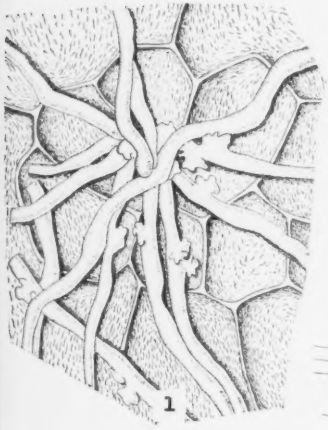
At the meeting of this Association held in Indianapolis in 1890, the writer presented a note on *Uncinula spiralis* B. & C., calling attention to a number of experiments which established the connection between the forms on Vitis and those on Ampelopsis. Since presenting the note in question some additional studies on the life history of the fungus have been made, and while these are not as complete as they might be, it is thought desirable to present the results here, especially as it is doubtful when further opportunities for work will be afforded.

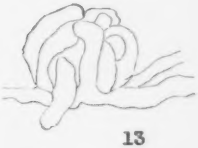
The fungus in question, commonly called the grape powdery mildew, is widely distributed in this country, occurring on various species and varieties of Vitis and also on *Ampelopsis quinquefolia*. In California and elsewhere on the Pacific coast the fungus is especially prevalent on varieties of *Vitis vinifera*, and it also attacks these plants in the eastern United States when grown out of doors and in greenhouses. What is doubtless the same fungus occurs in Europe, where it has long been known as *Oidium Tuckeri*. The native spore form of this fungus was wanting, however, for a long time on European vines, and it is only recently that Prillieux[2] has noted its occurrence in France. According to Prillieux, the perithecia found in Europe do not differ materially from those occurring in this country, and so far as such evidence goes there seems no reason to doubt the statements of Viala, Scribner, and others, that the forms are identical. The present paper is concerned only with the development of the fungus in this country, the studies for the most part being made upon material from the eastern United States.

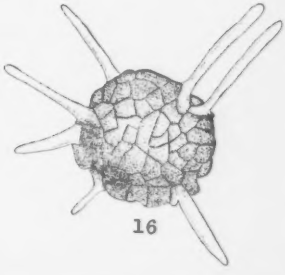
The Uncinula usually becomes sufficiently abundant to be easily found on cultivated varieties of grape, as well as on Ampelopsis, early in July. Toward the latter part of August

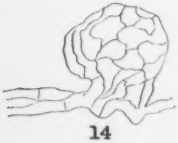
[1] Read before section G, A. A. A. S., Springfield meeting, August, 1895.

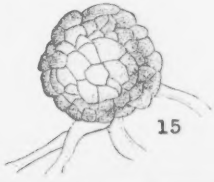
[2] Sur les perithéces de l'Uncinula spiralis en France et l'identité de l'Oidium Americain et de l'Oidium Européen. Bull. de la Soc. Mycologique de France **9**: 253. 1893.



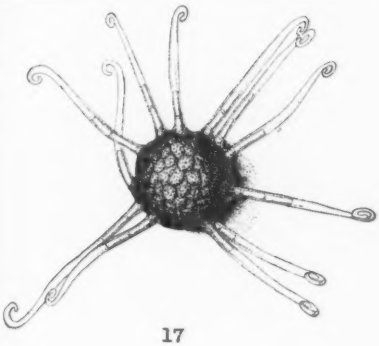




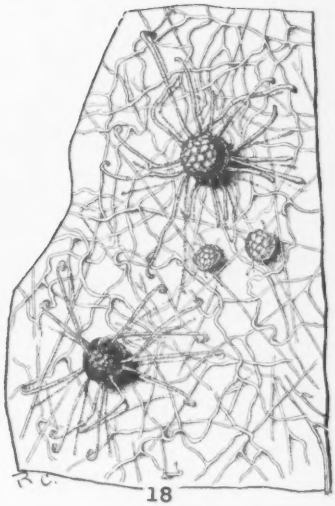




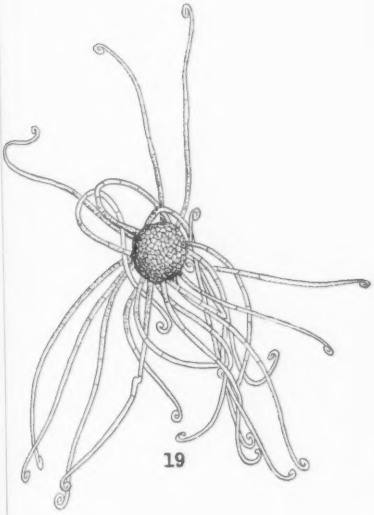
GALLOWAY on UNCINULA.



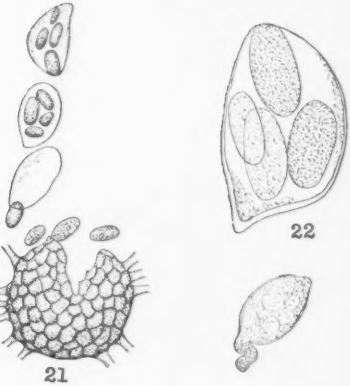
17



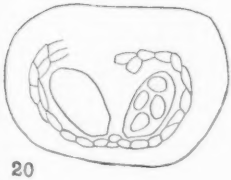
18



19



21 22



20

23

GALLOWAY on UNCINULA.

and during the months of September and October it may be found in an active stage on leaves, fruit, tendrils, and growing shoots, covering the same with a whitish, powdery, meal-like growth, which has caused it to receive its characteristic name. The powdery appearance is due largely to the presence of the mycelium and conidia of the fungus, which develop as described below.

Mycelium.—The mycelium consists of thin-walled, nearly hyaline, sparingly septate threads, which are very variable in thickness, but average from 6 to 7μ in diameter. The threads usually run in all directions, but show a tendency to converge at certain points (fig. 1), crossing and recrossing each other until a more or less thickened mat is formed. Although the mycelium does not become noticeably abundant until July, it may be found much earlier by carefully searching vines known to be susceptible to the attacks of the fungus. It occurs on such vines soon after the leaves put out, forming more or less rounded patches, which are difficult to see without the aid of a hand lens.

Haustoria.—At numerous points on the mycelial threads, more or less lobed swellings are formed (figs. 1 and 2). These are somewhat rounded on the upper side, but next to the leaf they are flat, clinging close to the surface. These swellings are the haustoria, and from their under side fine thread-like projections grow out and into the epidermal cells of the host. Once within the cell the end of the haustorial filament swells into a bladder-like body (figs. 3 and 4), which is filled with granular matter like that in the mycelium.

Conidia.—At numerous points the mycelial filaments send up short threads, which bear the conidial spores. These are formed by successive abjunction, from three to twelve being frequently found in one chain (figs. 5 and 6). When mature the conidia are oblong (the largest diameter being 20 to 30μ and the shortest 12 to 18μ), are filled with coarse granulated matter, and frequently contain two or more large vacuoles (figs. 7 and 8), which become more sharply defined as the conidium grows older. The conidia germinate readily in moist air or water, sending out one, and sometimes several, rather thick germ tubes (figs. 9 and 10), which seldom branch unless furnished nutrient material. The production of conidia continues until late in autumn, when the growth of the fungus, as well as that of other vegetation, is checked by frosts.

Perithecia.—Perithecia, in all stages of development, may be found as early as the last of July, occurring in most cases rather evenly scattered over the parts covered by the mycelium. Owing to the close interweaving of the mycelial filaments, it is difficult to make out clearly the changes which take place in the formation of the perithecia.[3] As a rule their development begins at the intersection of two or more mycelial threads. There is little regularity, however, in the matter, and nothing that could be looked upon as a sexual act. Usually short branches, with frequent septa (figs. 11 and 12) grow out from the main hyphæ. These twist around each other, forming a more or less close weft, globose in shape (figs. 13 and 14). At first the bodies are hyaline, but they soon show a brown tint and at the same time become more globular in shape. With increasing age the evidence of the short branches originating from the main hyphæ disappears, and later the walls of the peritheciabe come clearly defined (figs. 15 and 16). Soon after this there is developed from the outer walls of the perithecium eight to thirty appendages (fig. 16), which are at first hyaline and without septa, but later become brown near the base and divided by several cross walls. In the mature perithecia (figs. 17 and 18) the tips of the appendages are hooked and not unfrequently they are branched. The length of the appendages varies greatly, the form on *Vitis vinifera* from the Pacific coast (fig. 19) having especially long ones. Within the perithecia are found the ovate asci containing the spores. There are four to eight, rarely ten, asci in each perithecium, and from four to eight spores in each ascus. From studies made of imbedded material it appears that the dark-colored wall of the perithecium is composed of one or possibly two layers of somewhat thick-walled brown cells. Within this there are one or more layers of colorless cells (fig. 20*a*), which in the early stages at least fit close around the asci, and in some cases seem to extend into the interstices between the latter. These cells take stains in the same manner as the asci. In all the material

[3] After many attempts to find satisfactory material for the study of the development of the perithecia, the best results were obtained by gently boiling for half a minute small fragments of leaves containing fertile hyphæ and young perithecia in a solution of potassic hydrate. After this treatment the mycelium and young and old perithecia easily separate from the leaf and the weft of filaments may be easily floated on a slide, stained, and studied. The most satisfactory stain found was ordinary red ink diluted with 10 to 25 per cent. of its volume of water.

studied the perithecia seemed to be flattened on one side, the flattening sometimes amounting to a concavity. In such cases the asci were compressed vertically and considerably distorted. Doubtless part of the flattening was due to the shrinkage of the tissues during imbedding, but some of it was normal.

One of the principal objects of these studies was to follow the development of the fungus during the winter and to determine if possible when and how the ascospores germinated and the manner in which the host was infected in spring. It was deemed especially desirable to germinate the ascospores, as the evidence as to how this takes place in the Erysipheæ is comparatively meager. Leaves of both ampelopsis and vitis containing the perithecia of the uncinula were collected in the autumn and stored in several ways. Some were placed on the ground and covered with stones and boards, while others were tied up in cheese cloth sacks and the sacks were then thrown on the ground out of doors and tied to stakes in order to prevent them from blowing away. This last method was found to be most satisfactory, as when the leaves were covered with boards they rotted so badly that most of the perithecia were lost. Frequent examinations were made of debris under vines which had been attacked by the uncinula the previous summer. No material of value, however, was obtained in this way, all traces of perithecia disappearing early in December.

The first change of importance in the perithecia was the disappearance of the appendages. After December 1st it was rare to find a perithecium with all of its appendages intact. The hooked ends are usually the first to break off and soon the entire appendage disappears. The asci and spores undergo little change until the last of December, when many of them are found dead or more or less collapsed. All attempts to germinate the ascospores before January failed, and it was only after repeated trials through the months of February and March that success was attained.

The perithecia were from time to time removed from the leaves which had been exposed to the weather and placed in Van Tieghem cells, in the bottom of which was a drop of sterile water. Under these conditions the perithecia were kept properly moistened and could be examined with the microscope at any time. Perithecia collected after January 1st

and kept in Van Tieghem cells, as described, showed little or no change if allowed to remain perfectly quiet.[4]

After standing from a few days to a week or more, however, a slight jar was often sufficient to cause the perithecia to rupture and the asci and ascospores to escape. When this took place probably 8 per cent. of the ascospores collapsed, while the remainder either made no change or in the course of three or four hours began to send out germ tubes. The following case, which differs but little from others observed, illustrates the matter under consideration. Perithecia from the open ground were placed in Van Tieghem cells on January 7th. Twenty days later no change had taken place, the cell having been kept free from jars and other disturbances. The cell was then placed under the microscope and gently jarred with a needle, whereupon one of the perithecia suddenly burst and the asci began to escape into the drop of water surrounding the mass. The first ascus was violently ejected from the perithecium to a distance equal to about twice the length of the former. This was immediately followed by a second and a third ejected in the same way (fig. 21). The ruptured wall of the perithecium then closed and no more asci escaped. In coming through the ruptured walls of the perithecium the asci were more or less constricted, but they immediately assumed their normal shape as soon as they were entirely free. No sooner were the asci free than their spores began to escape or else to break up within the ascus. In the former case they escaped from the top, side, or bottom in much the same way as did the asci, but with less force. A large part of the spores burst as soon as they were free from the asci. In bursting the spores literally flew to pieces, the walls and contents being scattered in all directions. Nearly all the spores that failed to burst began to send out germ tubes in four or five hours, and at the end of twelve hours the tubes (fig. 22) had reached a length twice that of the spore or more. From a number of observations it appears that the sudden ejection of the asci is largely due to the abrupt contraction of the walls

[4] It was not uncommon to find perithecia which had been kept in water sending out long, hyaline filaments from the outer walls. At first it was believed that the spores within the asci had germinated and pushed their germ tubes through the perithecial walls. That this was not the case, however, was shown by the fact that when ruptured the asci and spores within were found in a normal condition. From the evidence at hand it seems more than likely that the mycelial filaments were direct outgrowths from the stroma-like wall of the perithecium. This matter, however, requires further study.

of the perithecium after being ruptured. The perithecium is doubtless filled to the point of bursting, pressure being greatest just over the apices of the asci. The least disturbance at this stage will cause a rupture at the point above noted and immediately the asci begin to go in the direction of the least resistance. During the passage of the thickest part of the ascus (*i. e.* the top), it moves quite slowly, and at this time the ruptured edges of the perithecium are pushed a little further apart. As soon, however, as the tapering portion of the ascus is reached there is a sudden contraction of the more or less elastic perithecial walls and in consequence the ascus is ejected with considerable force. After April 1st it was difficult to find perithecia containing spores and before the end of the month they had entirely disappeared. A number of attempts were made to infect grape and Ampelopsis leaves with ascospores, but the results of this work were in every case negative.

In conclusion I wish to express my thanks to Mr. D. G. Fairchild, my former assistant, who made a number of the sketches upon which the finished drawings accompanying this paper are based, and who also aided me in other ways.

Division of Vegetable Physiology and Pathology,
U. S. Department of Agriculture, Washington, D. C.

Explanation of Plates XXXII and XXXIII.

Fig. 1. Portion of upper surface of Ampelopsis leaf showing mycelium and haustoria.—Fig. 2. Isolated pieces of mycelium showing upper surface of haustoria.—Figs. 3 and 4. Haustoria within the epidermal cells of *Ampelopsis quinquefolia*.—Figs. 5 and 6. Chains of conidia.—Figs. 7 and 8. Isolated conidia.—Figs. 9 and 10. Germinating conidia.—Figs. 11–17. Development of perithecia on Ampelopsis. —Fig. 18. Portion of Ampelopsis leaf showing perithecia in different stages of growth.—Fig. 19. Perithecium from leaves of Vitis.—Fig. 20. Section of mature perithecium showing asci and colorless cells surrounding them.—Fig. 21. Perithecium which has just burst, showing relative position of ejected asci.—Fig. 22. Ascus containing four spores, drawn just before the escape of the latter.—Fig. 23. Germinating ascospores.

Notes from my herbarium. IV.

WALTER DEANE.

My baby flower press.

I always carry with me on my collecting trips a small press, consisting of two pieces of stiff card-board some six by five inches in size, filled with small blotters and pressing paper which I cut out from my large sheets used in the ordinary press. I use strong rubber elastics round the boards, and the little press can easily go into the pocket. The object of all this is to secure the flowers of many plants in a way almost impossible in the large press. It is most important for a well-furnished herbarium to be able to show the flower in all its details, that the student may have before him, spread out as in a printed diagram, the various parts of the flower, without resorting to boiling and dissection in order to find out the simplest facts as to number of stamens, position of petals, and the like. This my baby press enables me to do.

I am walking along the railroad track on a sunny morning, and I meet a fine specimen of *Lactuca leucophæa* Gray, a species of wild lettuce, its small purple heads of flowers broadly expanded to receive the warmth of the beautiful sun. How quickly those flower-heads will close and wither when the plant is picked! Even if put into the press on the spot, the flowers are apt to close and make a sorry show, for they are small and the stems of the plants prevent their receiving the needed pressure to keep them open. How many herbaria can show the open flowers of such species of the Ligulifloræ as *Lampsana communis* L., the nipple-wort, *Krigia Virginica* Willd., the dwarf dandelion, *Sonchus oleraceus* L., the common sow-thistle, and the like? This, however, can easily be done. When collecting the plant, pick off separate flowers and put them into the baby press, and, as you put the paper over them, hold them so that they will press wide open. Nothing is simpler. I find that there is no need of changing the blotters, since the flowers dry just as well without. In the case of such flowers as the fringed gentian, *Gentiana crinita* Froel., I section the corolla and press it open. This shows the appendages at the sinuses, so important a character in this genus.

A complete diagram of a flower is a most interesting feature to display, especially in the case of so curiously constructed a flower as *Sarracenia purpurea* L., the pitcher plant. Remove carefully all the parts, the three bracts, the sepals,

the petals, the umbrella-shaped top of the style with its stigmatic rays, and then make a cross section of the ovary and keep the fringe of stamens on with it. Press all these and either mount them on the sheet or put them in a paper pocket. I use both of these methods in my own herbarium. If the separate flowers belong to the same plant on the sheet with them, I always signify the fact by writing on the pocket, "From this specimen." This lends greater value to the plant in question. Sometimes one is obliged to take flowers from adjoining plants. In *Sagina procumbens* L., the pearlwort, my little press enables me to show clearly the minute petals, while my finest specimens of the flowers of the exquisite little *Arenaria Groenlandica* Spreng., the mountain sandwort, are those clapped into the baby press in a rain storm on the summit of Mt. Monadnock, N. H. Their wetting seemed to give them additional freshness, and the plants were so small that I put them into the little press entire.

I spent part of the summer of 1887 at York Harbor, Maine. My attention was naturally attracted especially to the seaside plants, and none interested me more than the eel grass, *Zostera marina* L. The inlets at the mouth of the York river were full of it, and the surface of the water was covered with the long ribbon-like leaves. The inflorescence is most beautifully adapted to the environment of the plant in the water. It must be seen in the fresh state to be appreciated. The narrow spadix, some two inches in length, is enclosed tightly in a delicate spathe, and at the time of flowering the ovaries thrust their exquisitely beautiful two-forked styles between the clasping edges of the spathe into the water, to receive from some other plant the pollen which has worked its way out from its home to assist in the great work of propagation. My baby press came to my aid in showing this inflorescence to the best advantage. I cut off a large number of the inflorescences and pressed them in various ways, with the spathe enclosing the spadix or opened so as to show the flowers in their natural position; I also drew the spadix out from the spathe, leaving it attached and allowing the spathe to close again. So now I have the plant complete, from rootstock to seed. One pocket contains drawings of the inflorescence, others contain the specimens made in my little press, and others still, the fruit collected at various places. I was even induced in this case to put specimens of the inflorescence into a small bottle of alcohol, and, as I look at them now, the ovaries are still vainly extending their finely forked style, as

when they left their briny home eight years ago, and the thread-like pollen is floating about, the whole telling the wonderful story of cross pollination in one of its thousand ways of adapting means to an end.

The most difficult task I ever gave my baby press was to prepare me a perfect diagram of the flower of a xyris. I think I may say that it is literally impossible to show the details of this flower in any other way. It is a poor withered blot in any pressed specimen of the plant. On August 9, 1888, I collected some fine specimens of *Xyris Caroliniana* Walt., the yellow-eyed grass, in Grassy Pond, Acton, Mass. The flowers were very beautiful as I gathered the plants. I had never realized that the xyris had a blossom with such exquisitely yellow petals. My herbarium showed nothing like it. Even when I put the specimen immediately into press, the hard scaly head allowed the blossom to wither. The operation of dissecting the flower was too delicate and too long a process to perform in the field, so I took home several flower heads in addition to my other specimens. I put them into a vase of water to get fresh blossoms in the morning. Sure enough when I visited them, a flower was slowly pushing its way up from behind its bract, and I saw, to my joy, that the flower was pushing ahead of it the anterior sepal which encloses the corolla, and falls as the blossom opens. How often had I read these words in the Gray Manual, "enwrapping the corolla in the bud and deciduous with it." Now I saw the performance for myself. As the flower opened, the sepal fell, and I caught it on the fly. Then, working under a lens, I dissected the flower and put into my baby press the three sepals, three petals with their inserted stamens, and the ovary with its three-cleft style. Attached to the base of the ovary are the three thread-like sterile filaments, beautifully cleft and bearded at the apex. I afterwards mounted them in diagrammatic form on a bit of white paper, and they are now in a pocket on one of my herbarium sheets, ready and anxious for inspection.

A pressed specimen of *Trapa natans* L., the water-chestnut, can hardly show the small white ephemeral flower in the center of the rosette of leaves. The press enabled me to do it, as I collected the plant on the Concord river in Concord, Mass. It is an introduction from Europe and has been in the river for years, thoroughly established and keeping company with *Marsilia quadrifolia* L., which is so abundant as to impede the oars as you row through it.

On a short visit to York Harbor, Maine, July 15, 1893, I took no press with me, for social duties made collecting out of the question. Walking along the cliffs with some friends, I noted the many plants about me, with the inward satisfaction that they were all duplicated in my herbarium. That feeling is always one of great gratification to me. Presently we reached a spot where we stopped to rest. It was close to the breaking waves and some ten feet above them, and as we sat down to enjoy the view, I noticed in the fine sand, which filled a shallow spot on the rock, some very small plants with purple flowers. The little fellows averaged an inch in height and covered the space of about a square yard. I confess that for a moment I was puzzled, for I did not expect to find such minute specimens of *Lythrum Hyssopifolia* L., the loosestrife. "Starve a plant," said Dr. Asa Gray to me once, "and it will flower immediately." This was when I showed him some seedling *Bidens cernua* L., the bur marigold, flowering half an inch above the cotyledons. I gathered them floating on a pond. Starved they were most certainly, and so was my loosestrife in the sand. An improvised baby press secured for me plenty of specimens. Contrary to the ordinary description of the species the flowers were very conspicuous. Indeed it was this that attracted my attention. The little roots had worked their way down an inch or two into the sand in search of the much needed moisture. On the following Aug. 13th, I received from my friend, who was spending the summer at York Harbor, perfect fruiting specimens of the plant from the same spot. The fruit was well developed, though the plants had not increased in size a bit. Fortunately the rains had given them moisure enough to sustain life. In fact for several days the little plants were entirely under water. My herbarium specimens of this species show the plant to vary in height from six to twenty inches.

I do not tell these little incidents, so interesting to me, to claim any credit. Far from it. Perhaps many others do the same things too. It is open to all who will take the trouble, and if the account of what I am doing will stimulate any collector to do the same, I know that it will give added zest to his work, and will enrich his herbarium with material which he cannot get in any other way.

Cambridge, Mass.

Noteworthy anatomical and physiological researches.

Root-tubercles on Ailanthus.[1]

The tumors upon roots of phanerogams have been studied extensively during the last decade. To the list of plants known to possess root-tubercles we can now add Ailanthus. Upon the roots of a tree of A. glandulosa cultivated in the botanical garden of Erlangen, Ernst Andreæ discovered numerous tubercles. These tubercles were outgrowths of very irregular shapes, varying from 5 to 40^{mm} in diameter and were most frequently grown together in clumps of three or more. The surface of the tubercles was scabrous, almost warty. One root showed a peculiar development of not only a number of these tubercles, but also an innumerable mass of lateral roots, all of which were of the same thickness and approximately of the same age. These roots were tangled up and more or less grown together, reminding one of some coarse fungus mycelium.

Two questions arise in regard to the origin of the tubercles: are they due to parasitic organisms, or merely to mechanical influences, disturbances in the functions of nutrition, etc.? The author bases his reply to these questions upon the results of a very careful anatomical study of the roots and the tubercles.

He describes minutely the structure of the various forms of tubercles. An old tubercle shows distinctly the original structure of the root, although the deformation is often so great that longitudinal and transverse sections are almost alike. This is seemingly due to the fact that the growing-points of new roots and root-shoots develop in almost any direction, and so the tubercle obtains its roundish shape. Most of these rudimentary roots and shoots do not develop any further. Sometimes, however, they grow so as to form lateral tubercles, but most often they constitute the warty mass which characterizes the surface of the tubercles.

Some fungi were observed by an examination of the structure of the tubercles. They were supposed to belong to the

[1] Ernst Andreæ: Ueber abnorme Wurzelanschwellungen bei *Ailanthus glandulosa*. Inaug. diss. Erlangen 1894.

Pyrenomycetes, but they were found in a very imperfect condition. Their occurrence was always merely local; they did not penetrate the entire tubercle, and the mycelium seemed constantly to decrease in size towards the center of the tubercle. Another fact observed was that the fungi only occurred in degenerated or decayed parts of the roots and tubercles. From this fact we might conclude that the fungi were saprophytic in nature, and had nothing to do with the malformation of the roots.

Comparing these tubercles with similiar ones on the roots of other plants, the author considers them to be nearly identical with those which Brunchorst described from *Cratægus prunifolia.*[2] The cause of their formation may be sought in purely external conditions, such as a sudden change in the nutrition of the plant or in some mechanical obstruction. In the present case it was found that the development of the tubercles was especially frequent whenever the roots struck sterile layers of sand, and they were thus at once deprived of their usual nourishment.—THEO. HOLM.

Studies upon galls.[3]

Pliny was the first to use the word gall (*galla*) as a name for these well-known outgrowths upon plants. The word has since been used for any pathological formation which appears as a thickening or swelling, and which is caused by insects, spiders, or fungi. The injury may, however, be of quite a varied character, and botanical terminology gives a large number of terms for distinguishing between the various forms, under which parasitism or pseudo-parasitism may occur.

Vuillemin[4] for instance has proposed the terms "antibiosis" and "symbiosis," according as the interference is or is not injurious to the host. But while this writer considers parasitism as intermediate between anti- and sym-biosis, Sarauw[5] uses parasitism as embracing all the various forms of anti- and sym-biosis.

The result of an antibiosis is probably always the develop-

[2] Brunchorst: Ueber einige Wurzelanschwellungen insbesondere bei *Alnus* und den *Elæagnaceen.* Untersuch. im bot. Inst. Tübingen 1885–88.

[3] Küstenmacher, Max: Beiträge zur Kenntniss der Gallenbildungen mit Berücksichtigung des Gerbstoffes. Pringsheim's Jahrb. f. wiss. Bot. **26**: —. 1894.

[4] Vuillemin, Paul: Antibiose et symbiose. Assoc. française pour l'avanc. des sciences. **18**: —. 1889.

[5] Sarauw, Georg F. L.: Rodsymbiose og Mykorrhizer. Bot. Tidsskrift. **18**: —. 1893.

ment of a gall, which, however, may show a marked difference in its exterior aspect and internal structure.

The cynips-gall may be taken as a good example. It is often globular and the anatomical structure shows the differentiation of two or more (frequently of three) concentric layers as follows: 1. The parenchymatic outer layer with epidermis, which contains tannin, and may therefore be called the tannin-layer. The cells of this tissue are mostly arranged radially. 2. The protective layer, Frank's "Schutzschicht" and Lacaze-Duthier's "couche protectrice," which most often consists of sclereids. 3. The inner or nutritive layer, Lacaze-Duthier's "couche alimentaire," which is composed of thin-walled parenchyma, the cells of which are frequently provided with large pores. This tissue contains an emulsion of oil, sugar and albumen; it is often very loose and shows large intercellular spaces. These layers are, however, not observable in all forms of galls; they are, according to the author, especially characteristic of the cynips-gall.

But if we consider galls in general, the author makes the following statements: 1. Vegetable tissues become developed, which enclose the animal embryos or fungus spores; or else the existing tissues become utilized for the enclosure or covering of these embryos or spores. 2. These tissues develop a nutritive layer.

The nutritive layer develops from its inner epidermis roundish sacs or long papillose hairs, or the cells may possess only pores, through which the nutritive materials can pass and become utilized by the larva. It would appear that vegetable galls might be produced artificially with the same success as has been done with the common fresh water mussel, where the introduction of a mustard seed developed a pearl. This does not seem to be the case, however, according to numerous experiments made by the author. The following substances were tried on plants: formic acid, acetic acid, tincture of cantharides, croton oil, mustard oil, lactic acid, potassium iodide, iodine, lead acetate, suet, albumen, yeast, and sugar. The injections were made by means of a horn pin, with which the author punctured the midrib of leaves or young shoots, and subsequently introduced the solutions through capillary glass tubes. He finally introduced a small piece of black mustard seed and covered the opening with court plaster. The result was, however, negative in all instances. Similar experiments

have also been made by Beyerinck,[6] who inoculated young leaves of *Salix purpurea* with the contents of the vesicle of *Nematus viminalis*, but without being able to produce the corresponding nematus-gall. One result was gained, however, which also confirms the correctness of Beyerinck's observations, viz., that neither the puncture itself nor the irritation which it causes to the plant is the real cause of the development of the gall, but that the larva of the animal or the fungus spore is the factor which produces the gall. It is, therefore, not difficult to prevent the development of a gall, and this can be done by killing the larva before the gall has reached its full size.

The author gives the history of the development of a number of galls from various species of wild roses, oaks, etc., and a systematic classification of the galls. This classification depends upon whether the galls are free or immersed in the plant; whether they contain one or more embryos; and according to the host, whether this belongs to the angiosperms, the conifers or the ferns. The occurrence of tannin in the galls is discussed at length, and there are many other points of interest in the work, so that it forms a welcome contribution to the study of vegetable galls in general.—THEO. HOLM.

The combined effects of geotropism and heliotropism.[7]

Dr. Czapek has recently obtained some valuable conclusions as to the interlocking effect of light and gravity stimuli. He finds that plants which are placed horizontally (for 60–70 minutes) until they have begun an upward geotropic curvature, when placed in an erect position and given a light stimulus on the previously lower side, will react to the light in exactly the same time as a control plant which has been standing upright meanwhile. On the other hand plants which were first given a heliotropic stimulus were greatly delayed in their reactions to a geotropic stimulus given later in an opposite direction. In the extension of the experiments plants were subjected to these two stimuli in every position from

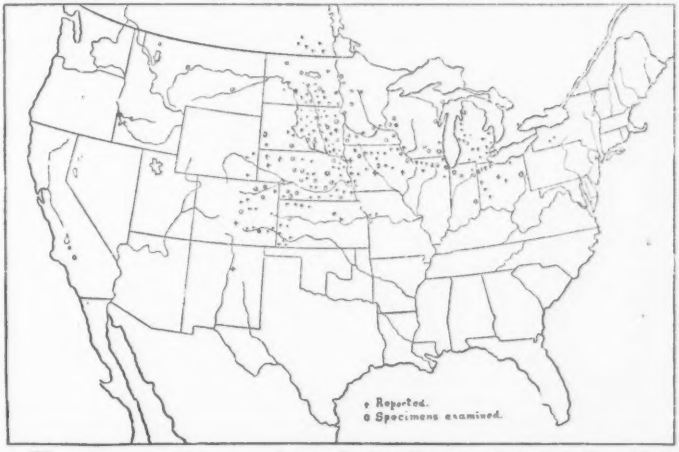
[6] Beyerinck, M. W.: Beobachtungen über die ersten Entwickelungsphasen einiger Cynipidengallen. Amsterdam 1882. Also: Ueber das Cecidium von *Nematus Capreæ* auf *Salix amygdalina*. Bot. Zeit. **46**: 1–11. 17–28. 1888.

[7] F. Czapek, Ueber Zusammenwirken von Heliotropismus und Geotropismus. Aus d. Sitzungsber, d. kaiserl. Akademie d. Wiss. i. Wien. math.-naturw. Classe **41**:—. Mr 1895.

vertically upright to a directly inverted, and it was found that the law of the "angle of incidence" of light does not hold when the light is given from below the horizontal. Further "that when an orthotropic organ is acted upon by two opposing stimuli, the resultant curvature will depend not only on the relative force of the stimuli but also on the position of the organ." The results of Dr. Czapek's work form an important addition to those which oppose the theory of "specific energy" of Johannes Müller which is upheld by Sachs and which forms the basis of Noll's speculations in his Heterogene Induktion. Incidentally, the prevalent views concerning plagiotropic organs are placed open to question.—D. T. MAC DOUGAL.

BRIEFER ARTICLES.

Distribution of the Russian thistle in North America.—During the past thirty years the Russian thistle, *Salsola kali tragus*, has been introduced over a wider range and has covered the infested territory more thoroughly than any other weed in America has ever done in the same length of time. Prickly lettuce, *Lactuca Scariola*, has a record for rapid distribution which approaches that of the Russian thistle but the prickly lettuce was introduced as early as 1863, while the Russian thistle was not here until ten years later. Even the Canada thistle which was abundant enough in Vermont a century ago to be proscribed by law as a noxious weed, has not in a hundred years covered much more ground than is now occupied by the Russian thistle. The data being collected regarding the rapid distribution of this weed will form an interesting chapter in the history of weeds in this country.



The accompanying map shows the distribution of the Russian thistle as indicated by the reports received at the Department of Agriculture during the past three years, corrected to October 30, 1895. If the plant has been discovered in any locality not indicated on the map, the undersigned would be glad to receive a report of it; and, if in any locality there indicated the plants have been exterminated, a report of the fact would be doubly acceptable.—LYSTER H. DEWEY, *Washington, D.C.*

Observations upon the dissemination of seeds.—In the fall of 1894 working as a student in Cornell University upon the dissemination of plants, I made a few rather interesting measurements, showing with some definiteness the effectiveness of certain adaptations.

My apparatus was very simple, two sheets of white cheese cloth, nine by twelve feet, to spread beside the plants and make the falling seeds more readily distinguishable, and a tape line for the measurements.

I worked first with two bushes of *Hamamelis Virginica* standing close together. They were about eight feet high, and had branches extending about four feet out from the main stem. Most of the capsules had been split across by previous frosts, and, on the clear October day of my observations, were opening as they dried. Apparently the inner woody layer of the capsule curves inward in drying, producing pressure upon the tapering ends of the polished seeds that is finally great enough to overcome resistance, when the seeds are shot away with considerable violence. In the case in question, shooting of the seeds began a little before one o'clock, continuing with increasing activity up to nearly five, and then diminishing in frequency until sunset. In this time upon the sheets, stretching as they did seventeen feet from the main stems of the bushes, and covering an area from nine to twelve feet wide, about one-fifth of a circle of the same radius, there fell no less than 153 seeds, of which a number were within four or five feet of the stems, many more at the extreme limit of the sheet, seventeen feet, but the largest number at a distance of about ten feet. How much farther they may have gone it is impossible to say, but one naturally infers from the numbers at the extreme limit of the sheet that some did go further. The distance travelled by the seed is doubtless dependent in large measure on the angle of the expelling capsule, plainly being greatest where that is forty-five degrees above the horizon, and the smallest when the pod is perpendicular. I am planning to make further measurements in the near future upon hamamelis and upon other plants which sling their seeds or fruits through their own mechanism; e. g., impatiens, oxalis, and others.

My other observations were made upon plants with upright or ascending pods opening only at the apex, a condition precluding the possibility of direct fall from the capsule to the ground, and rendering necessary a swaying motion of the plant and a consequent *throw* of the seed for its escape.

A plant of *Œnothera biennis*, twenty-one inches high with the lowest pods six inches from the ground, showed the following results in a light intermittent breeze of a late October day: At one observation

sixteen seeds were scattered toward the wind, the nearest at two inches, and with twelve between thirty-five and forty-three inches; and thirty went with the wind from eight to forty-seven inches away. Later the nearest were a few at four inches and more than sixty were scattered between twenty-three and thirty-six inches. Other observations taken at the same time on seeds of verbascum, dipsacus, and polanisia while less definite were nevertheless of the same general significance. Later observations on a new œnothera plant thirty inches high and with lowest pods eleven inches from the ground, extending over a longer period and with stronger winds, showed at one time the nearest seed alone at twenty-two and one-half inches from the plant stem, and upwards of 160 scattered over the sheet, being very numerous at the extreme limit, thirteen feet. At another time they were found in large numbers from four feet to the extreme limit.

During the same period observations upon *Datura Stramonium* with its erect prickly capsules and large pitted seeds gave the following results: one seed at five feet, one at four, and one at four and one-half; later one at one foot, twenty-two from two and one-half to seven and one-half feet; still later, fourteen scattered from twenty inches to ten feet, with perhaps the majority at about six feet. This plant was forty-four inches high with its lowest pods twenty-seven inches from the ground.

Thus, this modification is seen to be very effective. Its importance is realized when one notes that in the Cayuga flora seventy-five genera are so disseminated. These genera are scattered through widely separated families from the Juncaceæ to the Lobeliaceæ being especially abundant among the Scrophulariaceæ and the Caryophyllaceæ and quite numerous also in the Ranunculaceæ and Ericaceæ. Furthermore other modifications with similar effects occur; upright heads, the achenes often provided with embracing chaff, drooping pods opening only at the base, and persistent ascending calyx and bracts opening only upward.—Margaret Fursman Boynton.

Some western weeds, and alien weeds in the west.—A paper by Prof. L. H. Pammel, in a volume of the Proc. Iowa Acad. Sci., leads me to offer a few remarks. Prof. Pammel discusses in detail the distribution of certain weeds, and points out how little has been done to record the spread of introduced plants in this country. Two of the species thus discussed are *Solanum rostratum* and *S. Carolinense*. The latter species is not cited from Colorado or New Mexico, nor had I ever seen it in these regions, until this year I gathered it in an orchard at Albuquerque, N. M. The case of *S. rostratum* is widely

different, since it is a native of the west. Yet the only New Mexico record is one of Fendler, 1847! Prof. E. O. Wooton has found it at Riley's Ranch, on the west side of the Organ Mts., N. M., and I have observed it at Santa Fé; thus in New Mexico we get a vertical range of 2,000ft, viz., from 5,000 to 7,000. In Arizona Prof. Wooton found it at the Hardy water tank, eight miles east of Winslow; and this is actually the first specific locality in that territory, according to Mr. Pammel's account. This is also apparently the most western locality on record, as it is not reported from California, and was not found by the Death valley expedition. The first time I ever found *S. rostratum* was at Oxford, Furnas co., Nebraska, in July, 1887. In Colorado, while it is common on the plains at the eastern foot of the mountains, at least from Denver to La Junta (where I found it this year), it does not ascend into the mid-alpine zone. There is another *Solanum* which shares with *S. rostratum* the credit (or discredit) of being the original food of the Colorado potato-beetle, namely, *S. elæagnifolium*. This is in New Mexico a species of the upper and middle Sonoran zones, going up the Rio Grande valley, to my knowledge, from El Paso to Bernalillo, in great abundance. It does not occur in the Transition, at Santa Fé, except that this year I found there a single patch of it, growing vigorously. The characteristic species of *Solanum* at Santa Fé are *S. Jamesii* and *S. triflorum*, the former especially abundant. *S. Jamesii* I have never observed in Colorado, but *S. triflorum* is the common species of the mid-alpine zone, in Wet mountain valley.

At Santa Fé one finds many European weeds. It is probable that their presence is mainly due to the zeal with which the late Archbishop Lamy imported plants from France, the weeds coming accidentally with them. I found *Senecio vulgaris* quite abundant, also *Sonchus oleraceus* and *Plantago major*. *Erodium cicutarium* was found, and plenty of a dock which appears to be nothing but *Rumex obtusifolius*. There is also a large purple flowered Tragopogon in quantity; it can only be *T. porrifolius*, I assume. Finally, I was quite pleased to come across a good patch of *Convolvulus arvensis*.—T. D. A. Cockerell, *Agric. Exper. Station, Las Cruces, New Mexico.*

CURRENT LITERATURE.

The Kew Index.

The completion of this great work deserves special recognition, although the previous parts have been already noticed in this journal. It is difficult to overestimate its value to all those who deal with the names of flowering plants, and associated as it is with the name of Darwin, it becomes another proof of his sagacity. Drs. Hooker and Jackson and the staff at Kew are to be congratulated upon its prompt appearance, as well as upon its contents. With its 1,300 large closely printed pages of three columns each, it suggests an amount of work that is fairly appalling, and that could only have been accomplished within reasonable time with such force and material as are to be had at Kew. First appearing in 1893 it is a completed work in 1895, and hence is one of the few large works that is practically synchronous throughout. Botanists have already consulted it too extensively to need information as to its plan and purpose. The title page suggests that it is an "index to the names and authorities of all known flowering plants and their countries," with 1885 as the most recent date. In so vast a work it is impossible to avoid oversights and mistakes. It is only a wonder that they are not more numerous. Monographers will occasionally find that the reference cited is not the original one, but it usually takes a monographer to discover that.

There is one feature that we could wish had been different, and that is the matter of synonymy. A work of such great extent can not pretend to have made a monographic study of its whole field, and, therefore, much of the synonymy must be uncertain. We do not doubt that there is great familiarity with all plant groups at Kew, but in such a tremendous bibliography as the Index indicates, many of the expressions of opinion must have been "off-hand." It has seemed to us that if the Index had been a simple list of plant names, with no indications of synonymy, it would have been a fairer representation of the real value of the work. All questions of identity and of nomenclature might as well have been avoided, and the book made a record of fact rather than opinion. As it is, one can not be sure of the synonymy without investigation; and, if investigation be needed, what is the special value of the synonymy except by way of suggestion? This, if rightly understood, however, does not interfere in the least with the usefulness of the book, and botanists are under large obligation, as they have ever been, to Kew and Mr. Darwin.

The Synoptical Flora of North America.

When in the year 1878 Dr. Asa Gray's *Synoptical Flora* began to appear, botanists the world over hoped that the distinguished author would be permitted to complete it in a few years. In this way his vast experience with North American plants could be brought to the aid of subsequent botanists. The gamopetalous orders after Compositæ were the first to appear; then in 1884 the remaining gamopetalous orders. In 1886 a revision of these two parts, representing all our Gamopetalæ, was issued by the Smithsonian Institution. Ever since this has been the only part of our flora presented with any completeness, although monographs here and there have helped us out. The polypetalous orders were next attacked, and at Dr. Gray's death he had the work fairly outlined to the Leguminosæ. Certain large groups had been deferred, and these Dr. Watson was working upon at his death, in 1892. Now, seventeen years after the appearance of volume II, part I, the first fascicle of volume I, part I, has appeared,[1] under the editorship of Dr. Robinson, the third editor.

Dr. Robinson's task was a difficult one, for not only was he called upon to continue the work of our greatest systematist with work of reasonably equal quality, but he was compelled also to adopt a style of presentation not his own. It can be said without reserve that he has succeeded admirably, and that the part before us is a worthy companion of those we have already had. Recent questions of nomenclature cut no figure in a work whose mould was cast twenty years ago, while its great body of facts comes to us as the really desirable thing after all. The reviewer cannot but remember that Dr. Gray was a very progressive man, and is inclined to think that his successors have been handicapped by a rigid tradition.

Among the seventeen orders presented, interest naturally centers about the two largest, Ranunculaceæ and Cruciferæ, the former being the work of Dr. Gray, the latter the joint work of Drs. Watson and Robinson. An excellent editorial feature is found in the numerous footnotes giving supplementary references and information. The greatest pains have been taken to properly credit everything, all the recent species interpolated in the original manuscripts of Drs. Gray and Watson being indicated. In fact the whole work gives abundant evidence of the most painstaking care, and if anything pertinent has escaped mention it is certainly because it has escaped notice. It is out of the question to comment upon the numerous new forms de-

[1] Gray, Asa; Watson, Sereno; and Robinson, Benjamin Lincoln: Synoptical Flora of North America, Vol. I, Part I, Fascicle 1. Polypetalæ from the Ranunculaceæ to the Frankeniaceæ. American Book Co., New York, Cincinnati, and Chicago. Issued October 10, 1895.

scribed and the numerous opinions expressed in such a work. It will soon be in the hands of all working botanists, and it is sufficient to say that it is worthy of its predecessors. The history of this work, as of all extensive works undertaken by a single man, emphasizes the fact that although there may be a gain in uniformity, there is certainly a great loss in timeliness, and that such works are usually abandoned before completion. It is generally too difficult an undertaking, when one considers the extremely rapid evolution of botanical science, to profitably complete in uniform style a work which has been begun in a preceding generation. Now that we have seen the quality of Dr. Robinson's work we wish, as we have done for seventeen years, that some plan could be devised by which its completion could be hastened.

Saccardo's Sylloge Fungorum.

Another massive volume has now been added to the monumental work by Professor Saccardo[1] enumerating all described species of fungi. Ten volumes have previously been published, embracing descriptions of 38,163 species, to which the present volume adds 4,220 species. Of these 1,165 are North American fungi, chiefly new species published since June, 1892, an average of nearly 400 per year. They comprise Hymenomycetes, 118; Gasteromycetes, 14; Uredineæ, 92; Ustilagineæ, 17; Phycomycetes, 11; Pyrenomycetes, 388; Discomycetes, 101; Laboulbeniaceæ, 88; Saccharomycetes, 5; Myxobacteriaceæ, 9; Myxomycetes, 24; Sphaeropsideæ, 233; Melanconieæ, 68; Hyphomycetes, 44; Fossil Fungi, 3. The very rapid increase in the number of known fungi makes such a publication as the Sylloge one of great value to every working mycologist. This list of more than four thousand species is almost entirely the product of the botanical activity of only the last three years, and there is no likelihood of diminution for some time to come. The diversity in the methods and places of publication is astonishingly wide, and the necessity of such a work to one who desires to keep abreast of the mycologic literature is evident at a glance. To mention but a single illustration: of the ninety-two species of Uredineæ cited from North America, the original descriptions are published in twelve different periodicals, four of which are foreign. Other orders and regions might furnish even more conspicuous evidences of the indispensable character of the work.

[1] Saccardo, P. A.: Sylloge fungorum omnium hucusque cognitorum. Supplementum universale. Pars III. Adjectus est index operis universalis. Vol. XI. Patavii, July 1895. Roy. 8vo. 753 pp. 48 francs.

Handbook of British Fungi.

The modernization of Cooke's *Handbook* has reached the fourth volume. Although at first promised in three volumes, the enumeration has not yet been completed with a fourth one. The first two volumes have already been noticed.[1]

The two volumes[2] before us closely resemble the previous ones in their make up, with possibly some improvement in the execution of the illustrations.

The first two volumes with 268 pages of the third volume disposed of the Basidiomycetes. The remainder of the third volume treats of the Hyphomycetes; and the fourth volume takes up a portion of the Ascomycetes. There yet remain the Pyrenomycetes, Tuberaceæ (both in the table of contents of the fourth volume, but not otherwise appearing in it), Uredineæ, Ustilagineæ, Saccharomycetes, Myxomycetes, Phycomycetes, and some others, which together form about 38 per cent. of the contents of Cooke's *Handbook*. It looks very much as if two more volumes, at least, will be required to describe the remainder of the British fungus-flora. It is much to be hoped that the work will be continued until completed.

Much labor has been expended in the examination of type specimens, the augmentation and correction of the diagnoses, and the addition of spore measurements. Of the nomenclature it only need be said that about the expected number of changes occur, without any apparent attempt to adopt the radical methods which have recently come into vogue. A critical examination into the value of the new species and genera[3] and the shifting of the old ones would lead us too far.

The work is a welcome and valuable one as it stands, but it will be rendered far more useful if a general synopsis of the groups and a universal index are provided with the last volume.

Minor Notices.

A CAREFULLY PREPARED catalogue of varieties of wheat was issued in 1850 by the distinguished Louis L. de Vilmorin, based upon material which had been in process of collection for twenty years or more. This collection has continued to grow, and in 1889 a new catalogue was issued by the eminent Henry L. de Vilmorin, and now a

[1] **18:** 31, 240. 1893.

[2] Massee, George. British fungus-flora; a classified textbook of mycology. London, Geo. Bell & Sons. Vol. III, 1893. 512 pp. Vol. IV, 1895. 522 pp. 12mo.

[3] Cf. BOT. GAZ. **20:** 431. 1895.

second edition of the same is published.[1] It will prove of great service to students of wheat, both from the standpoint of the botanist and the cultivator. The finely engraved plates show heads of many varieties full size.

THE ANNUAL VOLUME from the U. S. Department of Agriculture[2] has taken on a new and greatly improved form. The report covering the year 1894 makes a volume of 608 pages well illustrated and printed, and attractively bound. The subject matter has also been put into a more pleasing form, and the quality carefully considered. It is a volume of information on important subjects, and probably the most valuable one ever issued by the Department. If this high standard is maintained (there is a promise that it will be raised), the questionable reputation of the annual volume must shortly give place to a well grounded esteem.

THOSE INTERESTED in the cultivation of greenhouse and window plants will find an excellent little book on the subject, just issued by Macmillan & Co. It is entitled "Greenhouse and window plants," by Charles Collins, and is sold for 40 cents. The excellent directions for the construction and management of greenhouses will be of great service also to departments of botany desiring such facilities.

A HANDBOOK OF GRASSES, by William Hutchinson, has been issued,[3] whose purpose is to popularize the study of that group. The British species are presented, with the aid of small woodcuts, preceding which there is a general discussion of structure of grasses. The groups are arranged for the convenience of field work, rather than in any natural order. There is the "agrarian group," the seashore group, the alpine group, etc. In the closing pages the subjects of geographical distribution and uses are rather fully presented.

---

[1] VILMORIN, HENRY L. DE.—Catalogue méthodique et synonymique des froments qui composent la collection de Henry L. de Vilmorin. 2nd ed. 8vo. 88pp. 16 pl. Paris, Vilmorin-Andrieux & Cie. 1895.

[2] Yearbook of the United States Department of Agriculture for 1894. 8vo. 608pp. 6 pl. and other illustrations. Washington, Gov. Printing Office, 1895.

[3] HUTCHINSON, WILLIAM.—Handbook of grasses, treating of their structure, classification, geographical distribution, and uses, also describing the British species and their habitats. Small 8vo. pp. 92. illustrated. London: Swan Sonnenschein & Co., New York: Macmillan & Co. 1895. 75 cents.

OPEN LETTERS.

The nomenclature question: Concerning homonyms.

In the September number of the GAZETTE Mr. Coville remarks that "probably the greatest objections that can be urged against the Association principles of nomenclature are those which may be brought forward relative to this very rejection of homonyms." But his explanation and examples do not in any way lessen the force of the criticisms of Dr. Robinson in the preceding number. This seems to be because no one, so far as I am aware, has yet properly distinguished between the rejection of revertible names within the limits of a genus, and their rejection when due to the varying conception of the limits of a genus. And this leads me to propound the question, What is a homonym? Among genera a name applied to one genus is never thereafter applicable to any other, and if so applied it becomes a homonym. Why should it not be equally true that a binomial which has been applied to one species is never thereafter, under any circumstances, applicable to any other species? In disregard of this principle, the recently published Check-List adopts the name *Anychia Canadensis* B. S. P. (1888), whereas it is acknowledged on the same page that Elliott applied this identical name to another plant as early as 1817! And thus a homonym, in the strict sense of that word, is adopted merely on the ground that the specific name *Canadensis* is older as applied to the former species! I do not understand by what stretch of the imagination *Anychia Canadensis* Ell. can be considered a homonym of *Queria Canadensis* L. In the same Check-List *Lespedeza frutescens* is proposed as a new name, notwithstanding the fact that Elliott, in 1824, used the same combination for a different plant. This, it appears to me, is a wholly indefensible and extremely pernicious principle.

Let us take another case. Every one will acknowledge that the two genera Silene and Lychnis are very closely related, and that some botanist might at any time unite them. If this were done, *Lychnis alba* Mill. (1768) would, according to the Check-List principles, become *Silene alba*, and *Silene alba* Muhl. (1813) would be relegated to the synonymy—there to remain forever—*Silene nivea* being substituted for it. Now suppose that the next writer upon this group should consider the two genera distinct. Again we would have *Lychnis alba* Mill., and the nomenclature of the two genera would stand as it does in the Check-List to-day, save that *Silene alba* Muhl. (a name which is now unchallenged) would have become *Silene nivea*, and must forever remain so, unless by some "lumping" or other jugglery this name too should be rejected, when a new one would have to be concocted. To generalize: if, of two large and closely related genera, A and B, A has the older name, the mere act of temporarily uniting B with A and then separating it again, may change permanently the names of some species of A, although these names may be otherwise unobjectionable. Can a rule which will permit this condition of things be a sound one?

Both Dr. Robinson and Mr. Coville express their dislike for theoretical objections. But what other objections can be made to a theoretical rule? It must be remembered that the principle under discussion has never been put into practice by any botanist who is inclined to "lump" related genera. Such botanists have existed in the past, and are sure to arise in the near future, and should they ever write in accordance with this principle, the present theoretical objections will at once become actual and overwhelming ones, and the present supporters of this principle will wake up, rub their eyes, and wonder why their rules don't work. It is my claim that nomenclatural rules, to be permanent, should provide for all foreseen possibilities.

It may be claimed by some that the utter disregard of the right of priority of a binomial, as such, is a principle copied from the zoologists. If so (and I am not sufficiently acquainted with their usages either to deny or to affirm it) I feel constrained, as does Dr. Millspaugh in considering decapitalization, "to speak against the tendency of many botanists to follow a bad example set by zoologists."[1]

To sum up: it appears to me that the recognition of the *priority of binomials*, and, so long as it does not conflict with the former, of the *priority of specific names*, possesses all of the advantages, and none of the disadvantages, of the *rejection of revertible names*. It will thus be seen that I am a firm believer in priority law, only consistency requires me to recognize the right of priority for binomials; and further, I believe heartily in the rejection of homonyms, provided only the word "homonym" be taken in its proper sense. The suggestions here brought forward would settle the case of *Juncus megacephalus* and all other cases which Mr. Coville has presented, in the way in which he would like to see them settled, and at the same time would do away with Dr. Robinson's objections, as published in the August GAZETTE. I feel sure that the leaders of reform, with whom I am thoroughly in sympathy, will strengthen their cause by rejecting any weak principle, instead of clinging to it when it has been proven untenable.—JOHN HENDLEY BARNHART, *Tarrytown, N. Y.*

Decapitalization.

Opposed, as I am, to the spelling of names derived from persons without a capital letter, I should nevertheless like to ask Mr. C. F. Millspaugh a question or two. How can *nevadensis* ever mean *of the whiteness of snow?* Is there a Latin scholar in existence who would not understand that *bajaensis* means *coming from Baja?* Is it not the case that in nearly all languages, except English, the adjectival form of place names is written with a lower case initial, while only the substantival form is written with a capital? In short, should we not write *Scutella blaviensis*, but *Scutella Besanconi*, *Scutella calvimontana*, but *Scutella Morgani?* Mr. Millspaugh will observe that I write this entirely from the point of view of the classical scholar, and not from the point of view of the systematic biologist, who must, I fear, be left to his ineptitudes whether he be zoologist or botanist.—F. A. BATHER, *British Museum.*

[1] Bot. Gaz. **20:** 429. 1895.

NOTES AND NEWS.

A FINE ILLUSTRATION of Yucca Whipplei, reproduced from a photograph, appears in *Garden and Forest* for October 16th.

MR. DRUERY, in *Gardener's Chronicle* (Sept. 28th), reports a "bigeneric" fern hybrid between Scolopendrium vulgare and Ceterach officinarum.

IN CONNECTION with Professor Huxley's death it is of interest to call attention to his single paper on systematic botany, entitled, "The Gentians: notes and queries." It was published in 1887 in *Jour. Linn. Soc.*

THE INFLUENCE of spray and rain on the forms of leaves is a topic written upon by Conway MacMillan in *Science* for October 11th. He takes several recent articles by foreign botanists as the basis of his discussion.

THE RARE *Rhus Michauxii*, of North Carolina and Georgia, is described and figured in *Garden and Forest* (October 9th). Dr. Sargent believes it to be the most poisonous of the North American species.

DR. HARVEY W. WILEY, Chief of the Division of Chemistry, Department of Agriculture, has just published a bulletin containing an account of his analyses of cereals collected at the World's Columbian Exposition.

A FEW COPIES of the *Uredineæ Americanæ Exsiccatæ* published by Mr. M. A. Carleton in 1894 can still be obtained of the author (Agric. Dep't, Washington, D. C.). Only one fascicle of fifty specimens was issued, and the publication has been discontinued. The price is $2.50, or $2.75 in foreign countries.

MOLISCH recently showed that the phycoerythrin of the Florideæ is a crystallizable proteid substance,[1] and in a still more recent paper[2] he demonstrates the same for phycocyanin. The solubility of its crystals in water, its loss of solubility (coagulation) after treatment with boiling water, alcohol, ether, and dilute acids, its capacity for swelling, taking stains and easy decomposition, together with its proteid reaction, leave no doubt of its proteid nature.

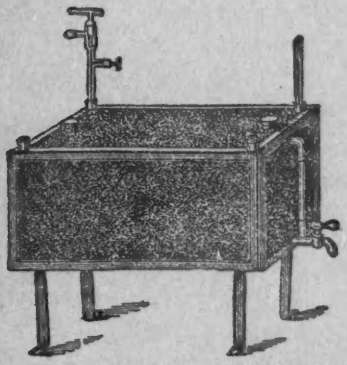
MR. D. T. MACDOUGAL has been promoted as Assistant Professor of Botany in the University of Minnesota, in charge of graduate and undergraduate work in vegetable physiology. The department will shortly erect a range of plant houses, in anticipation of which, Prof. MacDougal was sent to Europe last summer by the university, with a view to inspecting the best practice in European botanical gardens. An article from his pen, with the title "Botanic Gardens," appears in the *Minnesota Magazine* for October, separates of which have been distributed.

[1] Bot. Zeit. **52:** —. 1894.

[2] Bot. Zeit. **53:** 131. 1895.

Henry Heil Chemical Co.,

ST. LOUIS, MO



CHEMICALS, GLASSWARE

AND OTHER APPARATUS FOR CHEMICAL, BOTANICAL, AND BACTERIOLOGICAL LABORATORIES.

—

IMPORTERS OF

SPECIAL APPARATUS FOR Vegetable Physiology.

GIVE US A TRIAL. YOU WILL FIND US PROMPT AND CHEAP.

Before Ordering Elsewhere, Get Our Quotations.

Large Illustrated Catalogue on Application.

OUR NEW

1/12 OIL IMMERSION OBJECTIVE

SEND POSTAL FOR DESCRIPTION AND PRICE

BAUSCH & LOMB OPTICAL CO.

ROCHESTER, N. Y. NEW YORK CITY

GRAY'S

Synoptical Flora of North America

VOL. I, PART 1, FASCICLE 1

RANUNCULACEAE TO FRANKENIACEAE

PUBLISHED OCT. 10, 1895, BY

Cambridge Botanical Supply Company

1286 MASSACHUSETTS AVENUE

CAMBRIDGE, MASS.

Sent postpaid on receipt of $2.60

SEND NAME AND 2c STAMP FOR "THE BEST LIST OF BOOKS" for naturalists and students in botany, entomology, geology, ornithology, and all natural history.

Edition nearly exhausted. 33 copies only remain of

THE FERNS OF NORTH AMERICA,

By the late **Prof. D. C. Eaton.**

Illustrated with 81 full-size colored plates. 2 vols. 4to, cloth, gilt top. Net, $40.00.

WILD FLOWERS OF AMERICA. By Prof. G. L. Goodale. 51 colored plates by Isaac Sprague. 4to, cloth, $7.50.

*** For sale by all booksellers, or

BRADLEE WHIDDEN, Publisher, 18 Arch St., Boston, Mass.

SPECIALLY PREPARED

Herbarium Paper for Botanists

This paper is offered at the moderate price of $5.50 per ream. We also furnish—

No. 1 Genus Cover,	16½ x 24 inches,	at	$4.00	per 100
2 "	"	"	2.50	"
3 "	"	"	1.50	"
Dryers,	12 x 18	"	2.00	"
Species sheets,	16½ x 23½	"	.50	"

Orders will receive prompt attention. Write for samples.

E. MORRISON PAPER CO.,

1009 Penna. Avenue, N. W., Washington, D. C.